

Response of ES to muons/pions

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Outline

- Available HG Runs
- Muons:
 - Extraction of muon Signal
 - Fitting minimum-ionizing particle peak.
- Pions:
 - Extraction of muon Signal
 - Fitting minimum-ionizing particle peak
- Do we see some energy dependence on particle energy?
- Pion/Muon signal shapes for the same sensors
- Summary

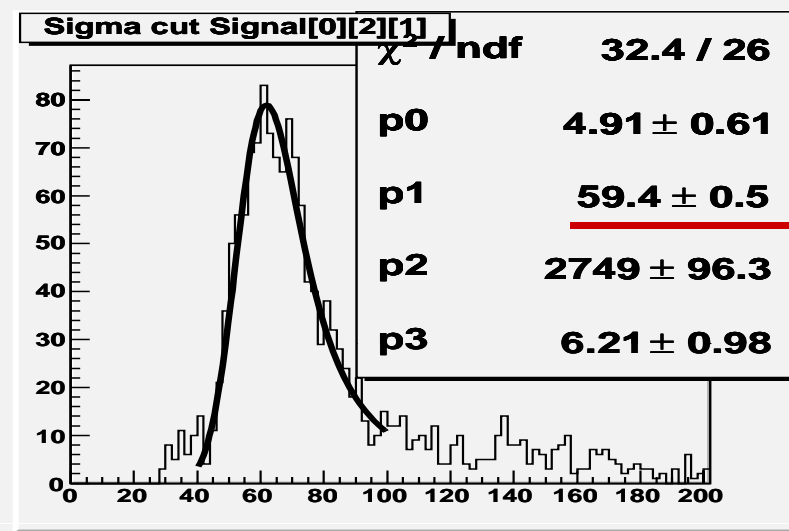
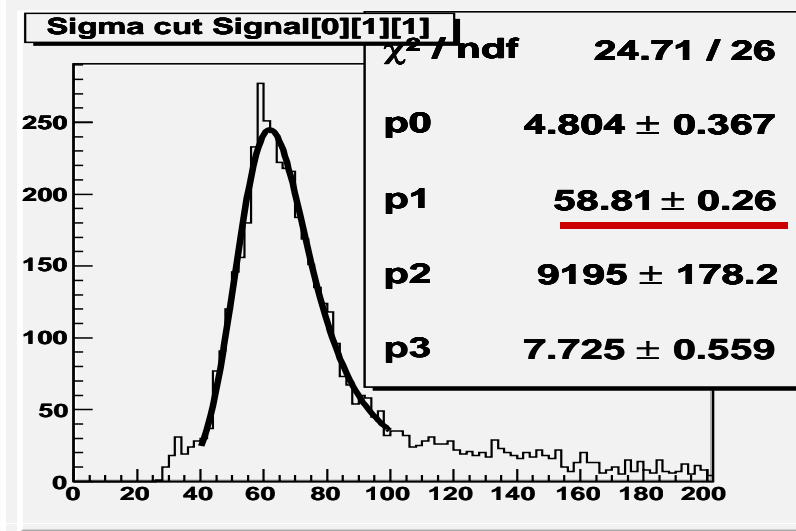
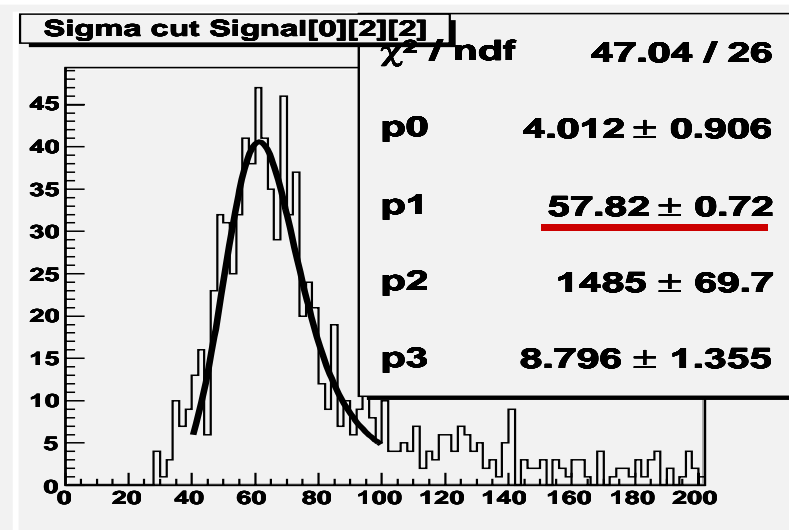
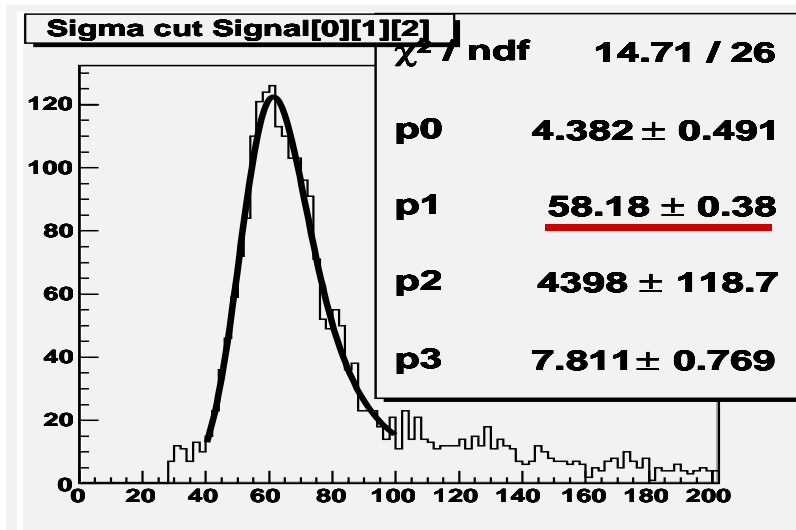
Available HG runs

RUN NO	Particle	Energy (GeV)	Total Events	Data events	Pedestal events
15964	μ	225	10 K	8739	1261
15965	μ	20	10 K	5287	4713
15635	π	2	10 K	7436	92564
16024	π	20	37368	29044	8324

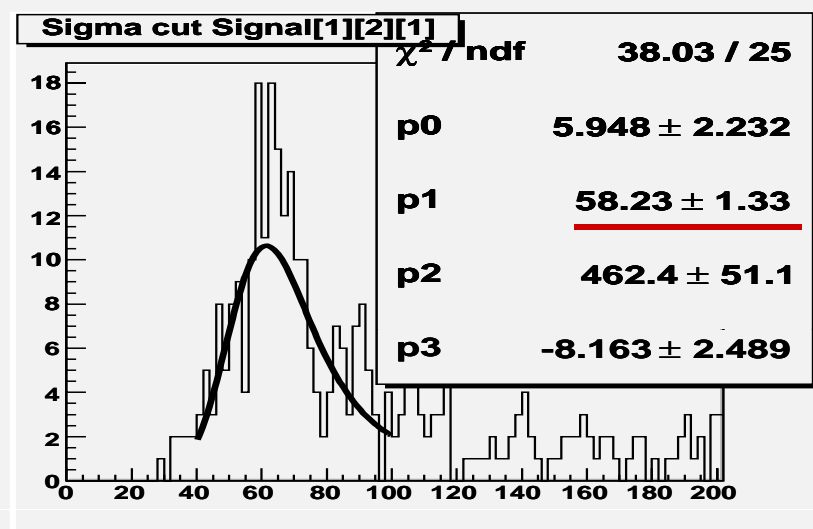
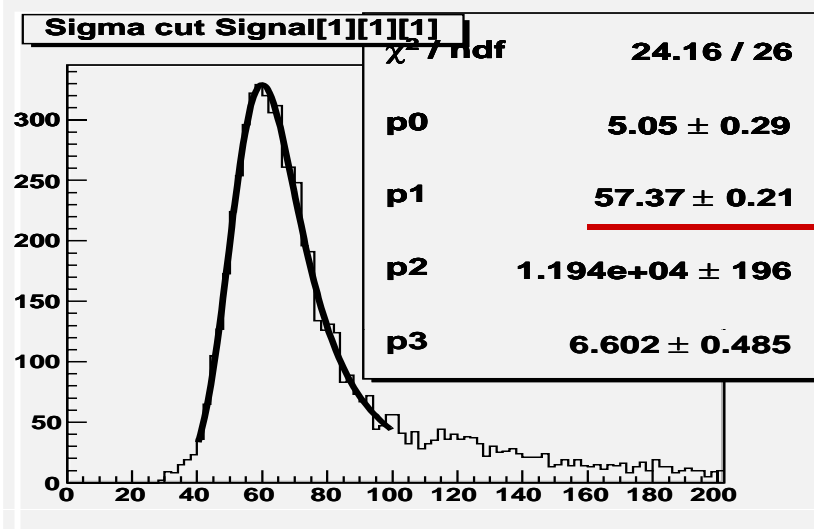
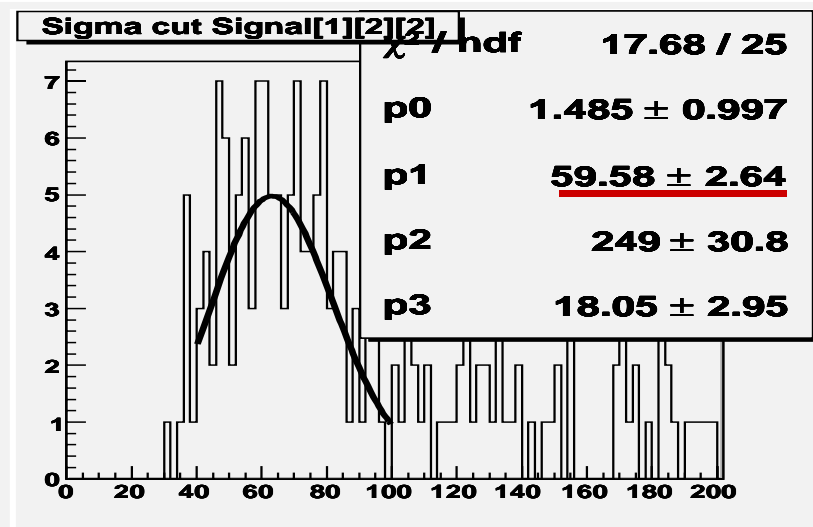
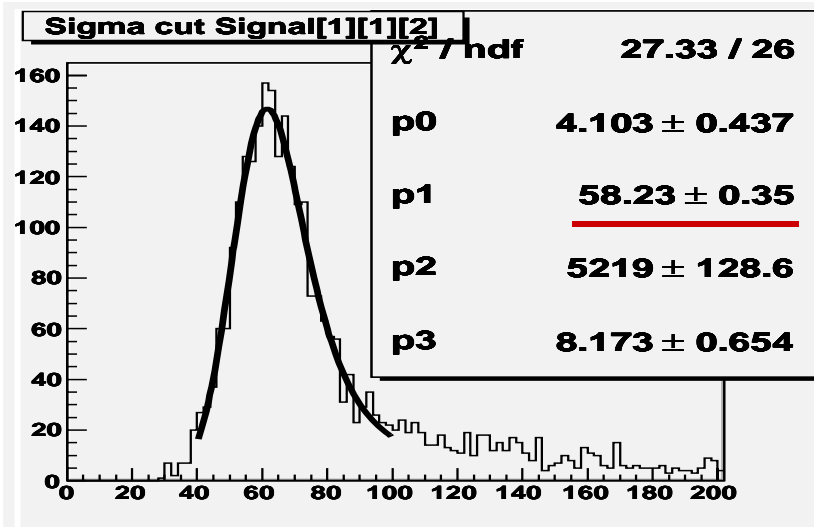
Muons-Pions

- Concentrate to the “central” 4 sensors where beam was hitting
 - Layer 1&2 : Sensors [1][2], [2][2], [1][1], [2][1]
- Total signal extraction per sensor
 - Pedestal subtraction and CM correction (done in ntuples)
 - Evaluate signal per strip by combining the three time samples using Poter’s $W1, W2$ and $W3$ (for HG)
 - Apply a 5σ threshold on every strip ($\text{Strip_signal} > 5 * \text{Strip_noise}$)
 - Signal = Sum all strips above threshold (No clustering)
- Fit data to a Landau convoluted with a Gaussian distribution
 - Parameters : p0 Width parameter of Landau density
 - p1 Most probable value
 - p2 Integral
 - p3 Width of convoluted Gaussian

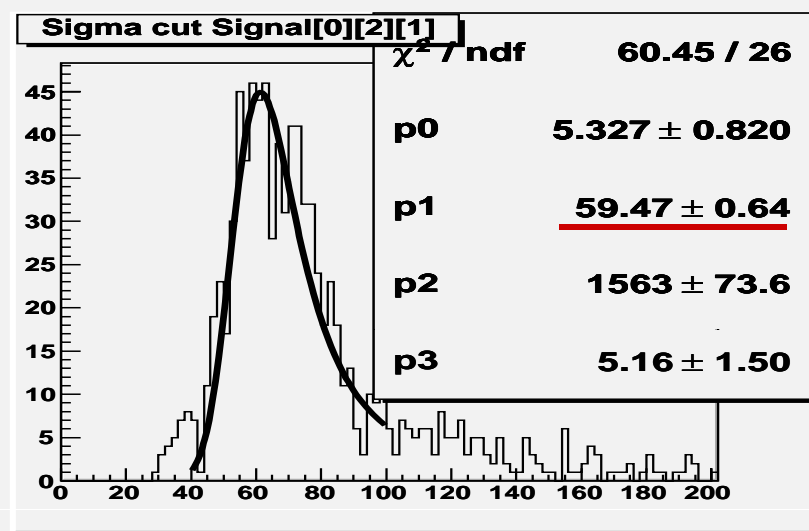
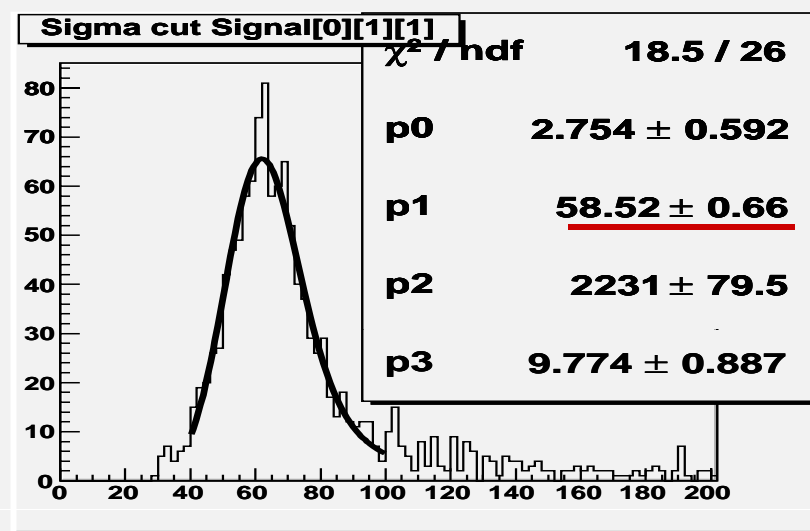
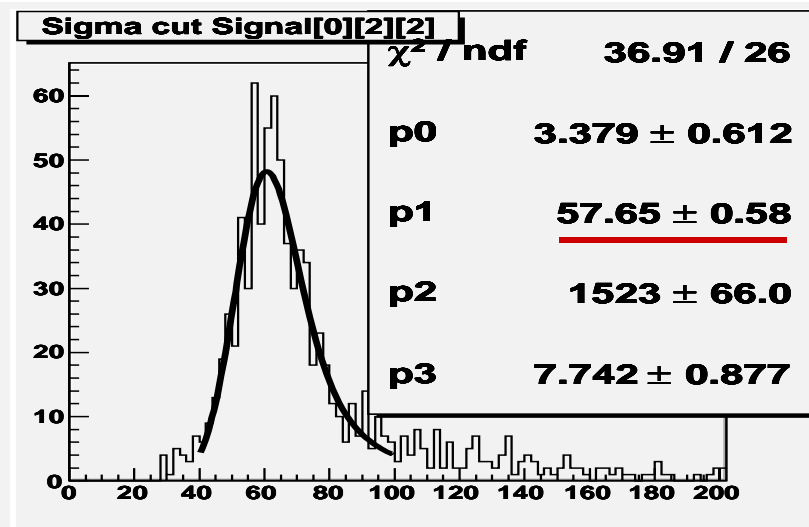
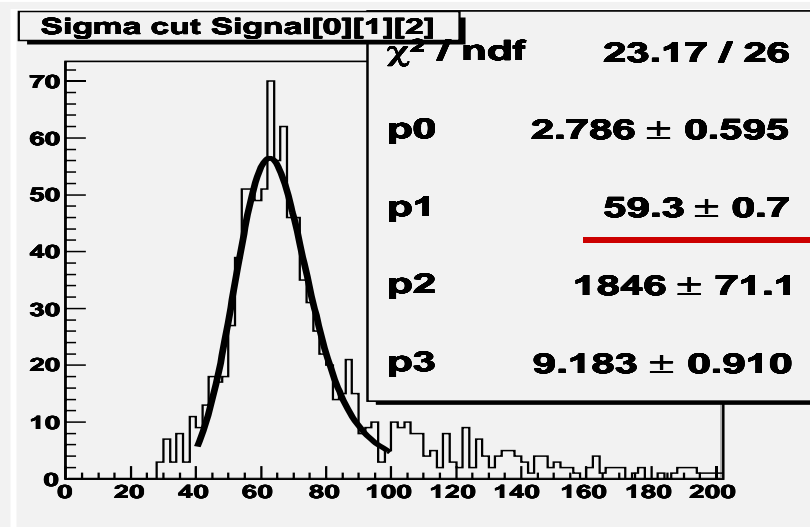
Muons: RUN 15964 (225GeV) Layer 1



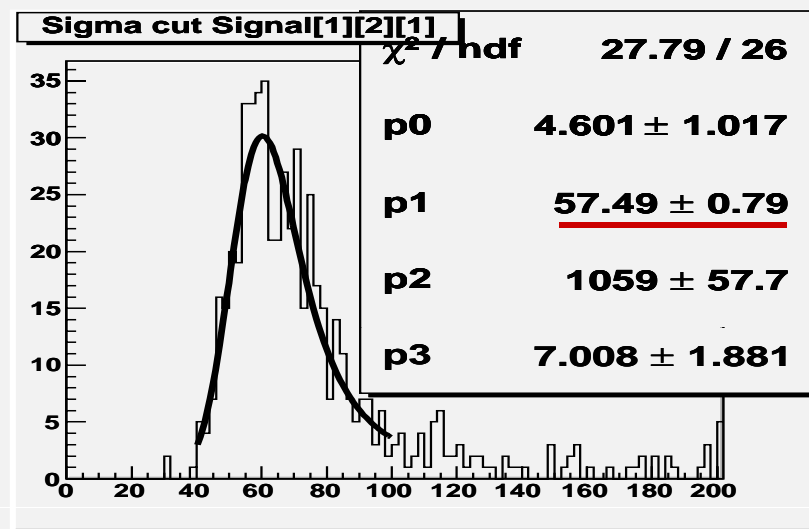
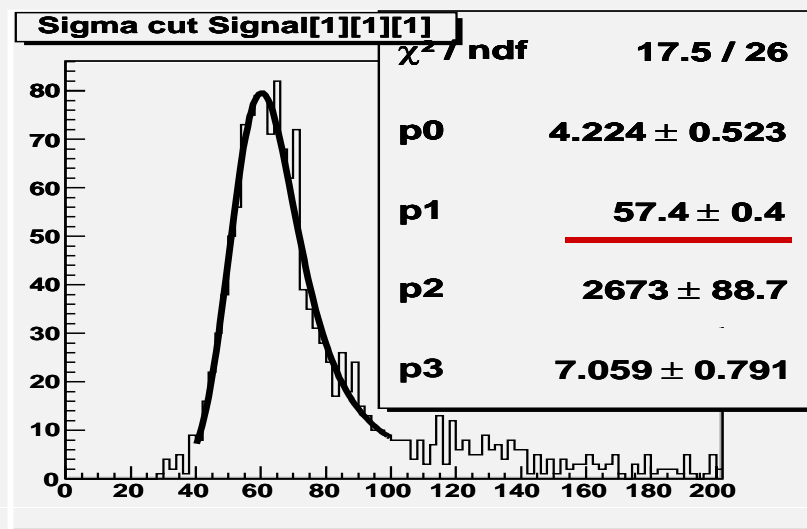
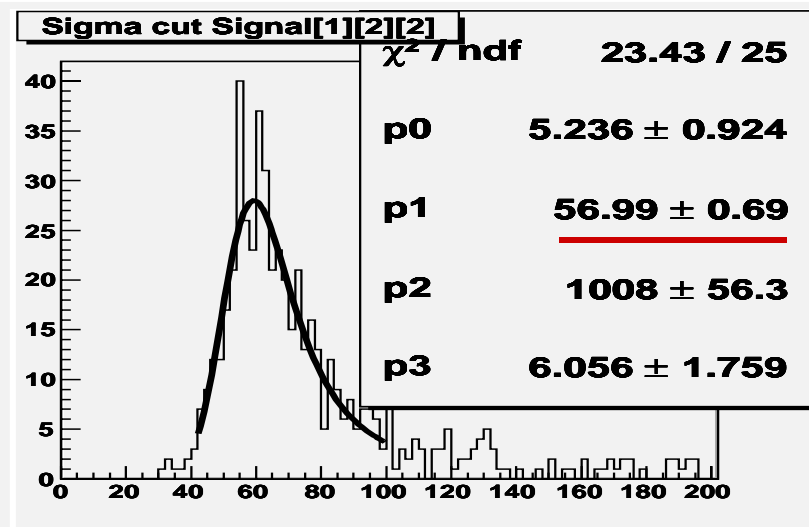
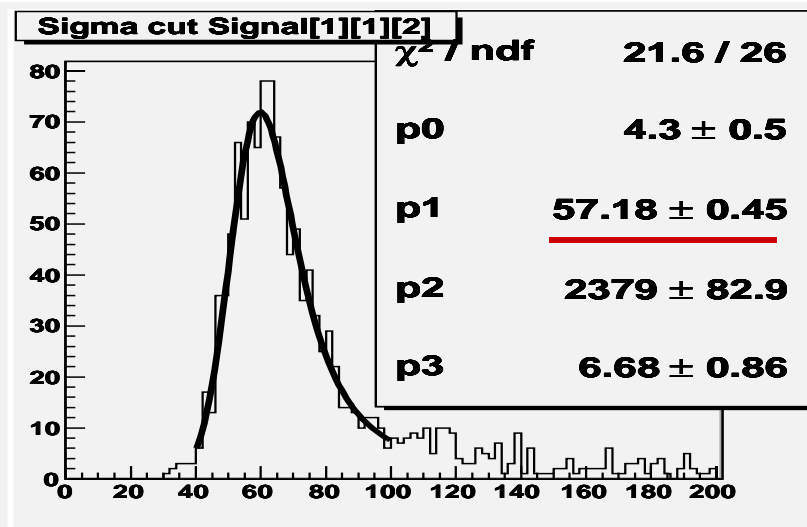
Muons: RUN 15964 (225GeV) Layer 2



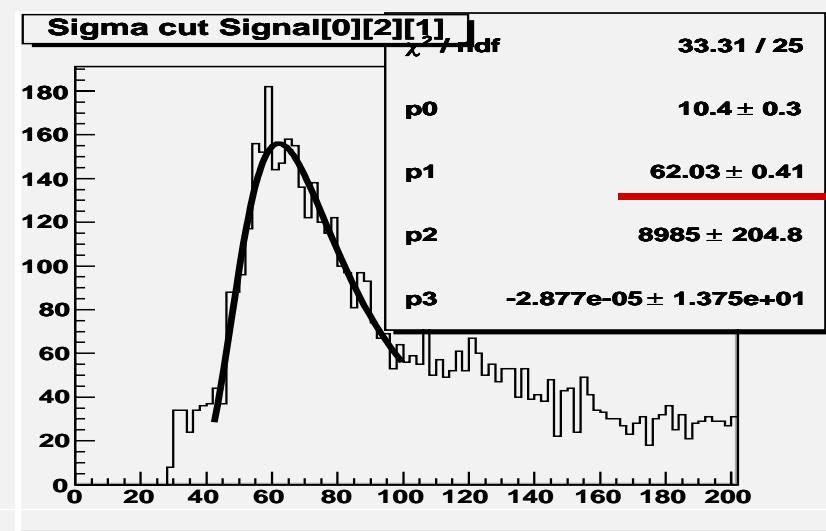
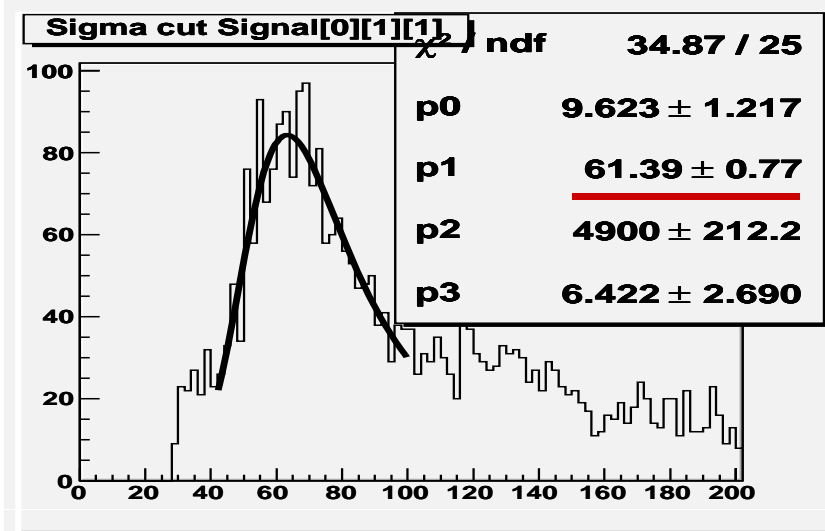
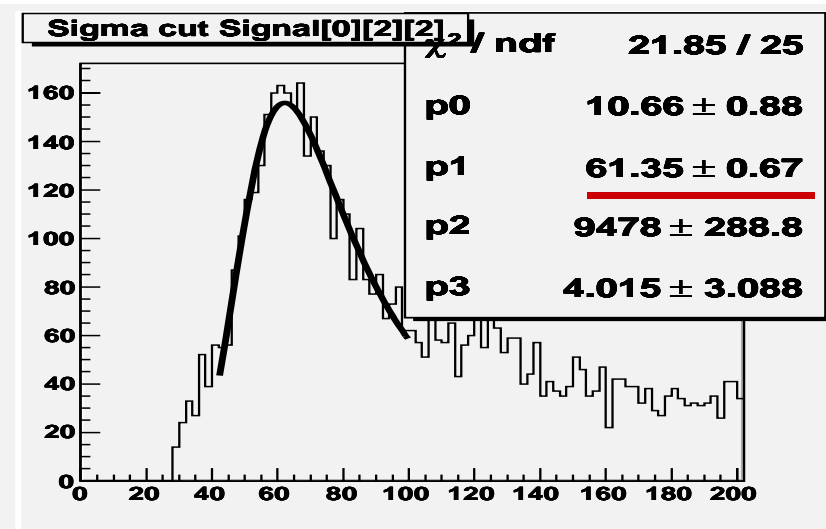
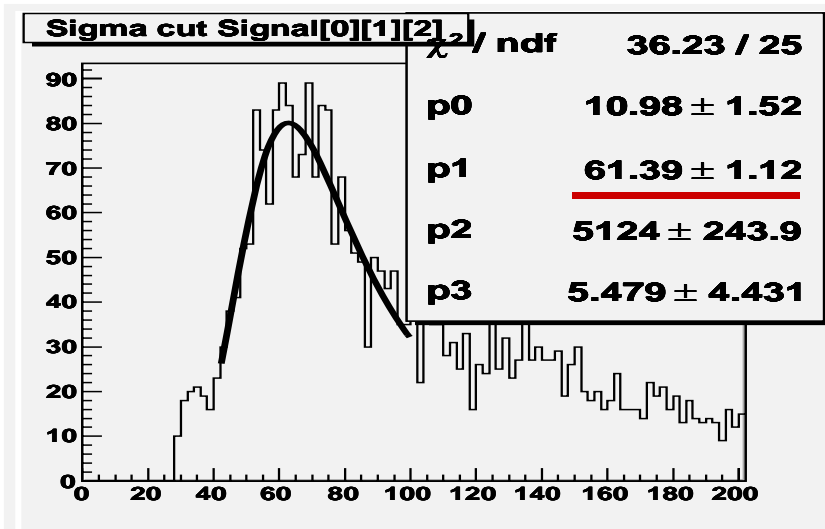
Muons: RUN 15965 (20GeV) Layer 1



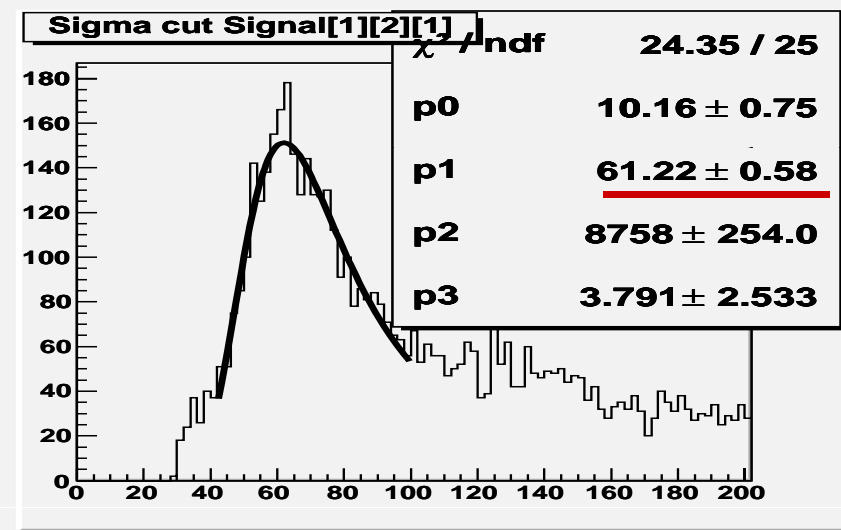
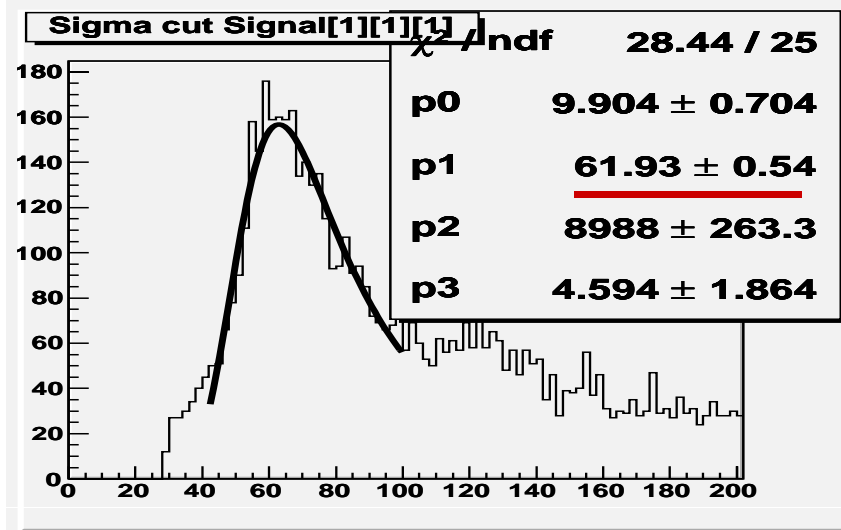
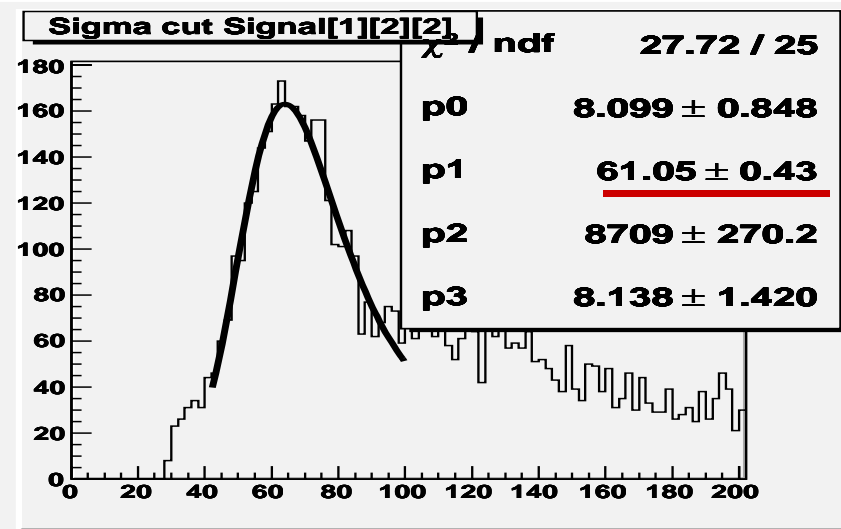
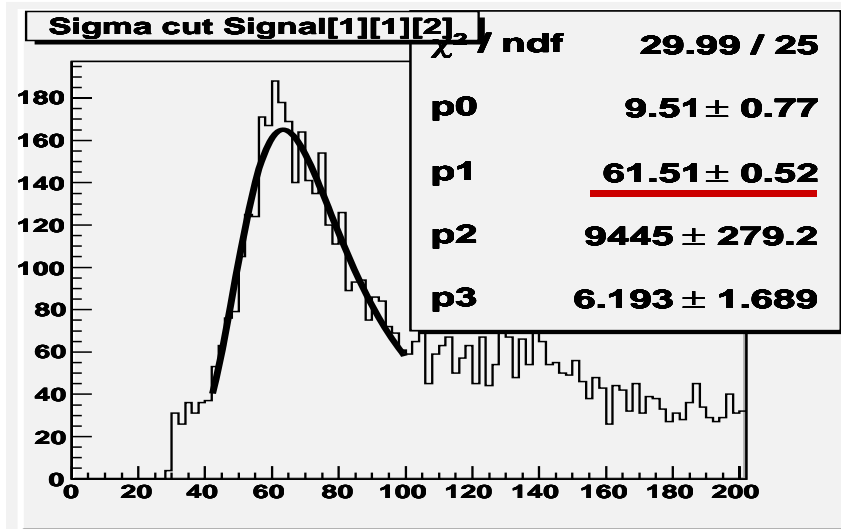
Muons: RUN 15965 (20GeV) Layer 2



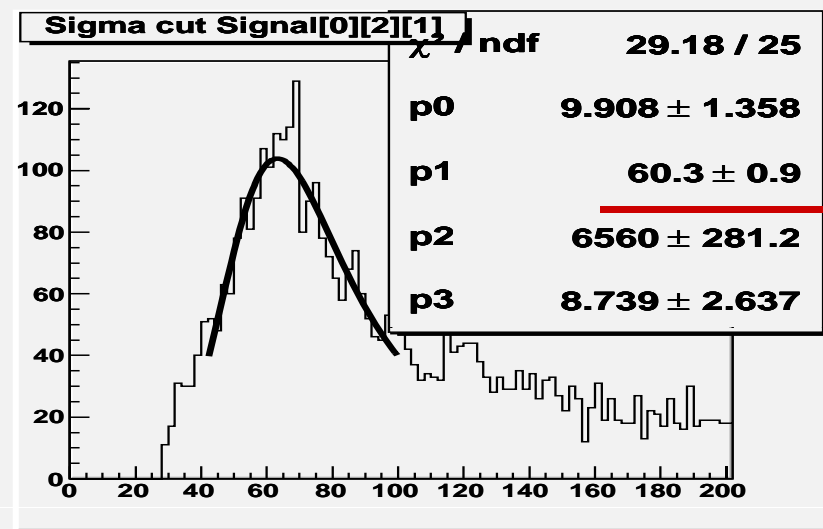
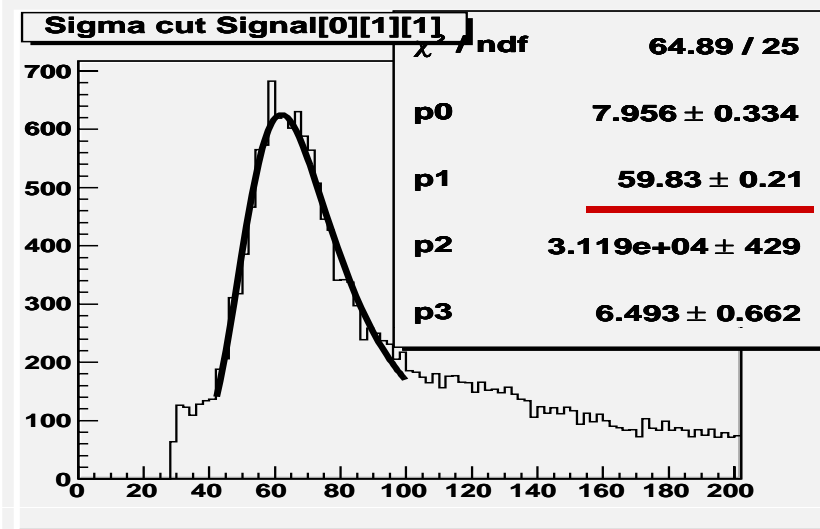
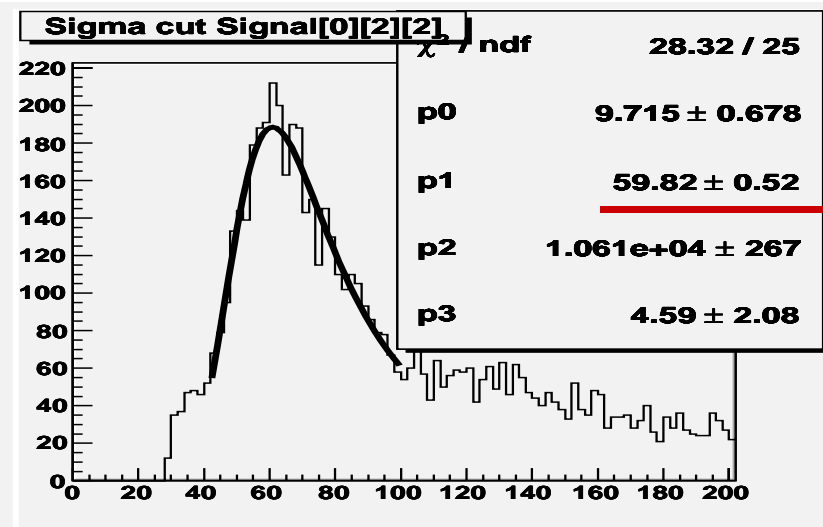
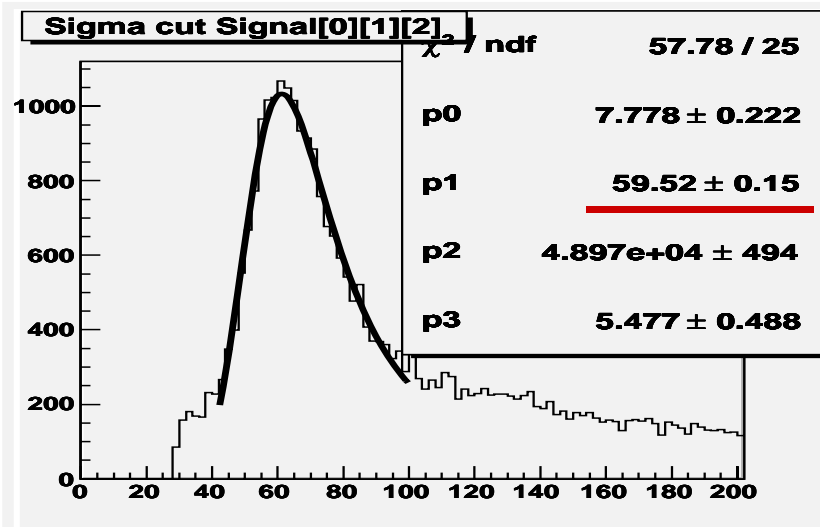
Pions: RUN 15635 (2 GeV) Layer 1



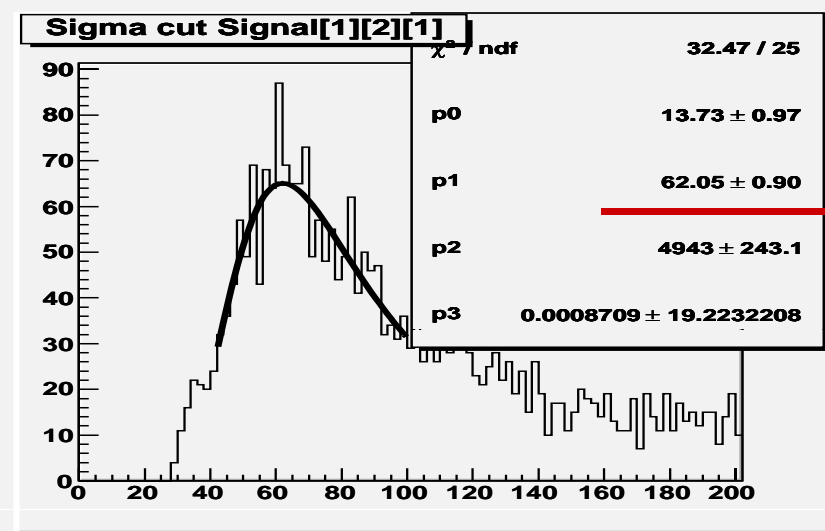
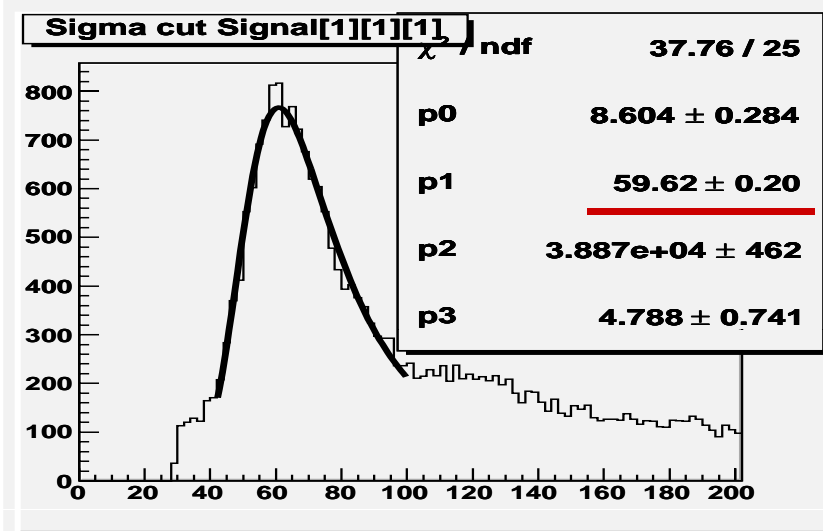
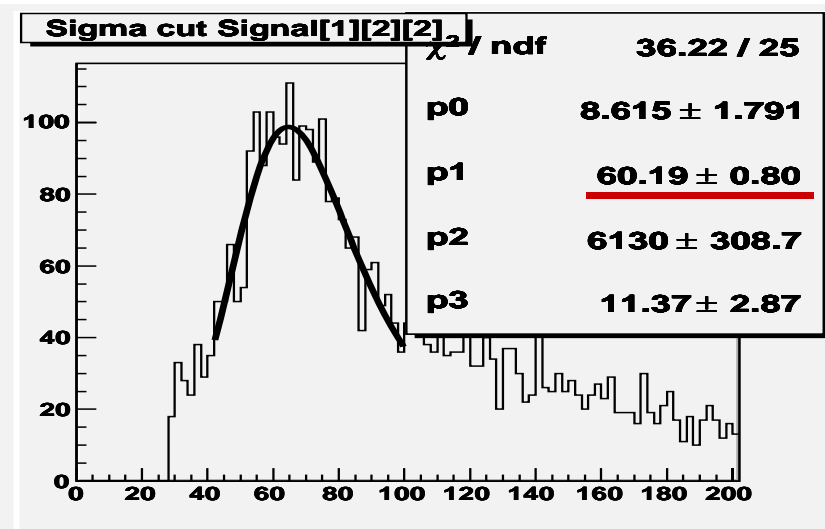
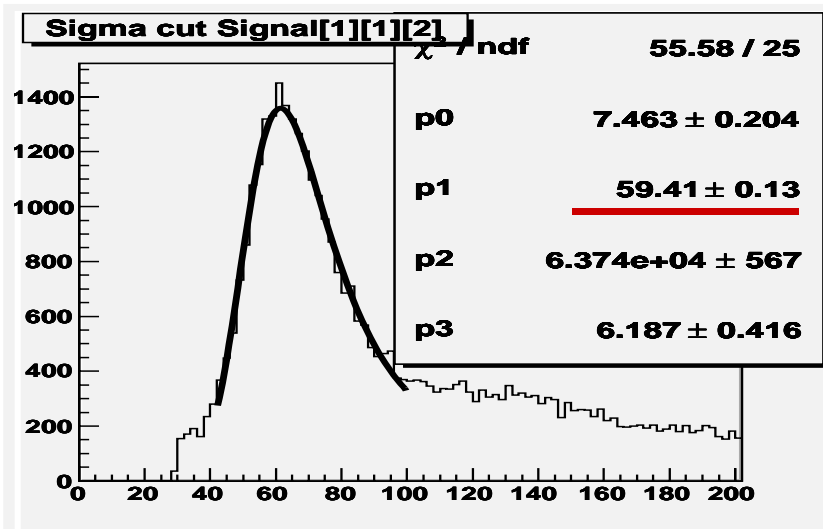
Pions: RUN 15635 (2 GeV) Layer 2



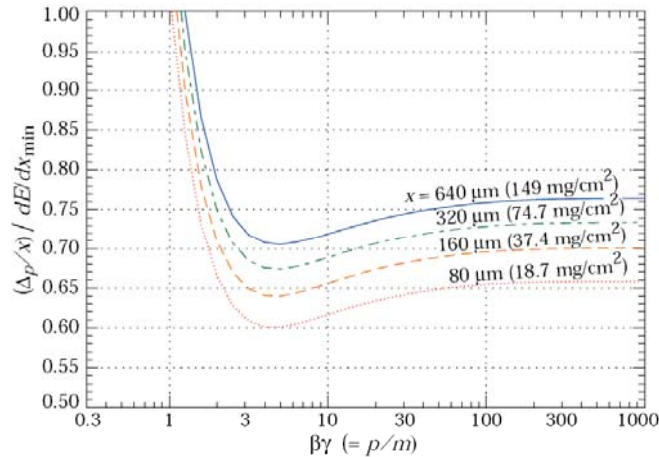
Pions: RUN 16024 (20 GeV) Layer 1



Pions: RUN 16024 (20 GeV) Layer 2



Energy Dependence?



PDG: Passage of Particles through matter

Figure 27.7: Most probable energy loss in silicon, scaled to the mean loss of a minimum ionizing particle, 388 eV/μm (1.66 MeV g⁻¹cm²).

RUN NO	Particle	E (GeV)	βγ	[Δp/x]/dE/dx _{min} (320μm)	MPE (KeV)	MPE (mips)
15964	μ	225	~2130	~0.735	~91.1	1.09
15965	μ	20	~189	~0.73	~90.5	1.08
15635	π	2	~14	~0.70	~86.8	1.04
16024	π	20	~143	~0.73	~90.5	1.08
-	-	-	~4.5	~0.675	~83.7	1

} ~4%

Energy Dependence?

**Layer 1
Sensor [1][2]**

	MPE
μ (225 GeV)	58.2 ± 0.4
μ (20 GeV)	59.3 ± 0.7
π (2 GeV)	61.4 ± 1.1
π (20 GeV)	59.5 ± 0.2

**Layer 2
Sensor [1][2]**

	MPE
μ (225 GeV)	58.2 ± 0.4
μ (20 GeV)	57.2 ± 0.5
π (2 GeV)	61.5 ± 0.5
π (20 GeV)	59.4 ± 0.1

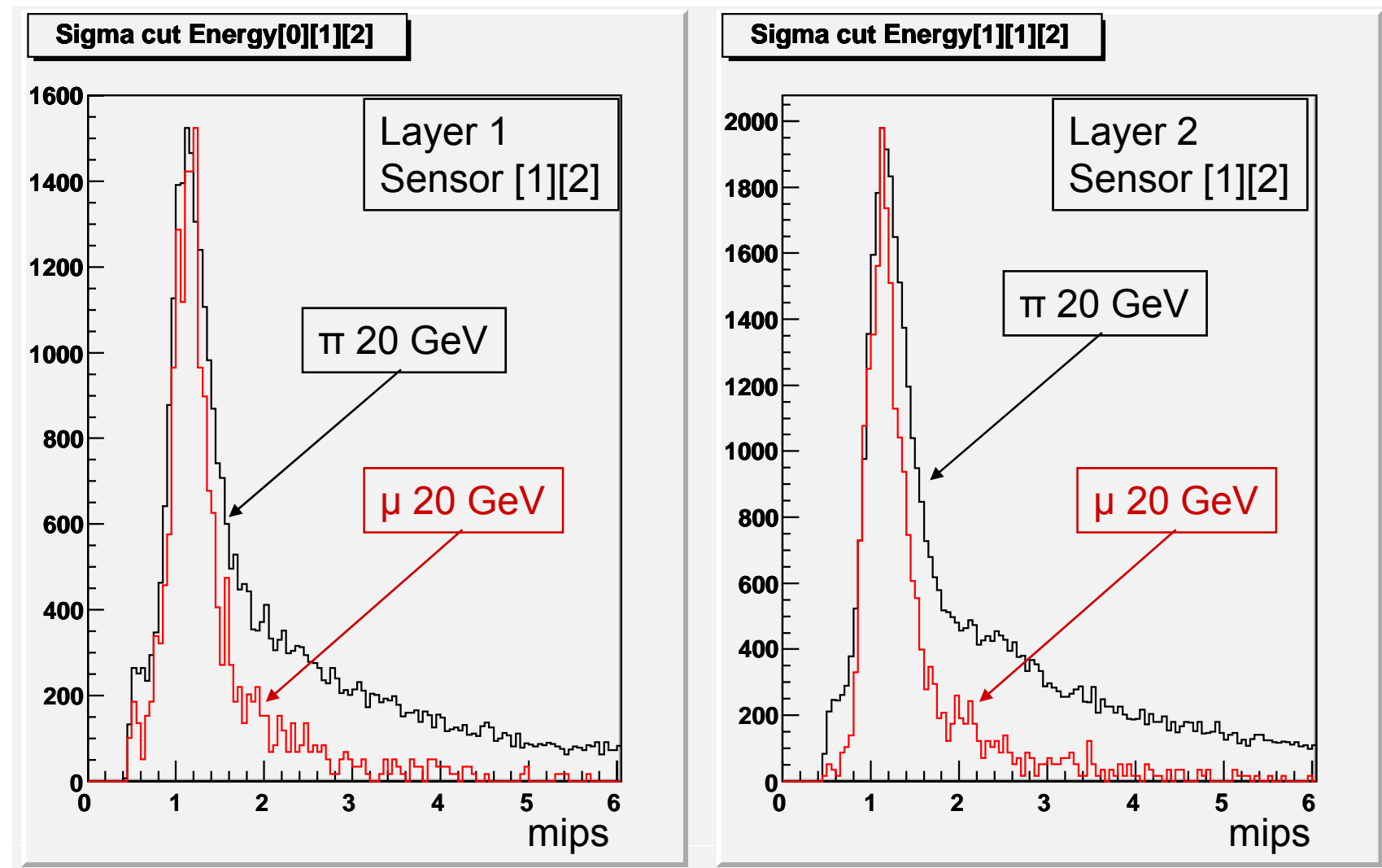
} ~3-4%
Reverse!!

We observe the reverse effect of what we expect!

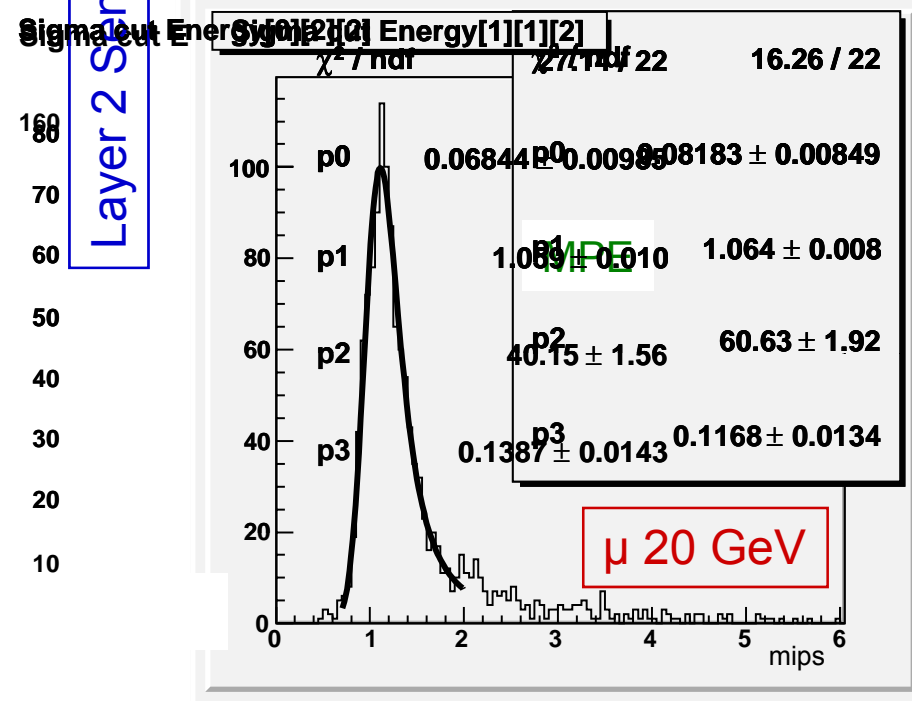
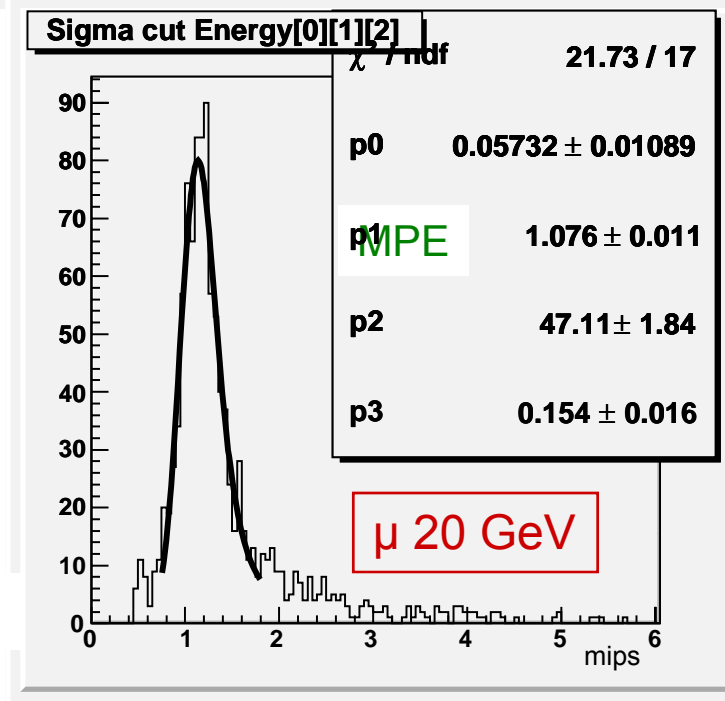
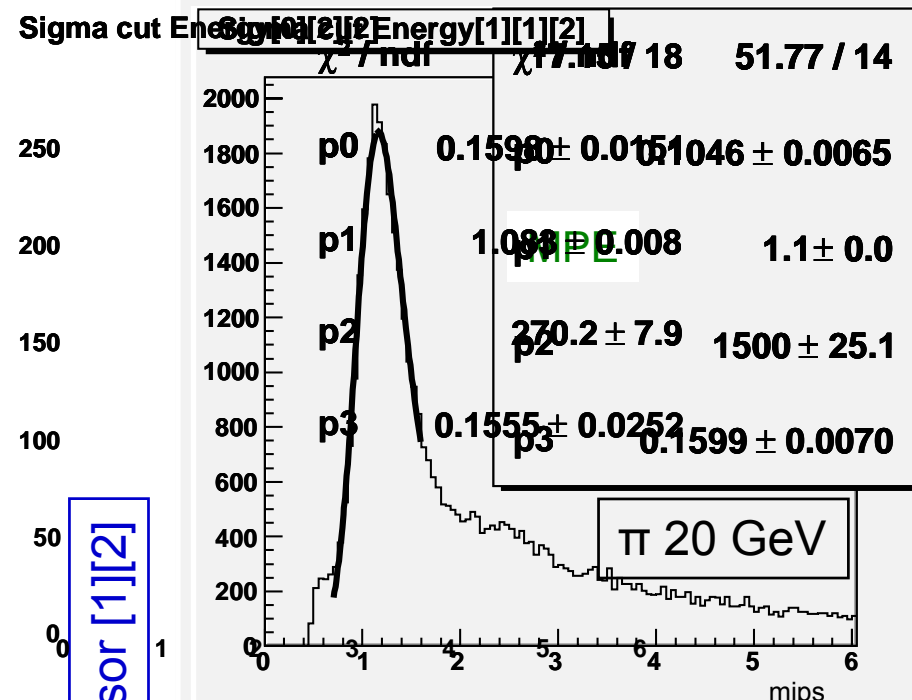
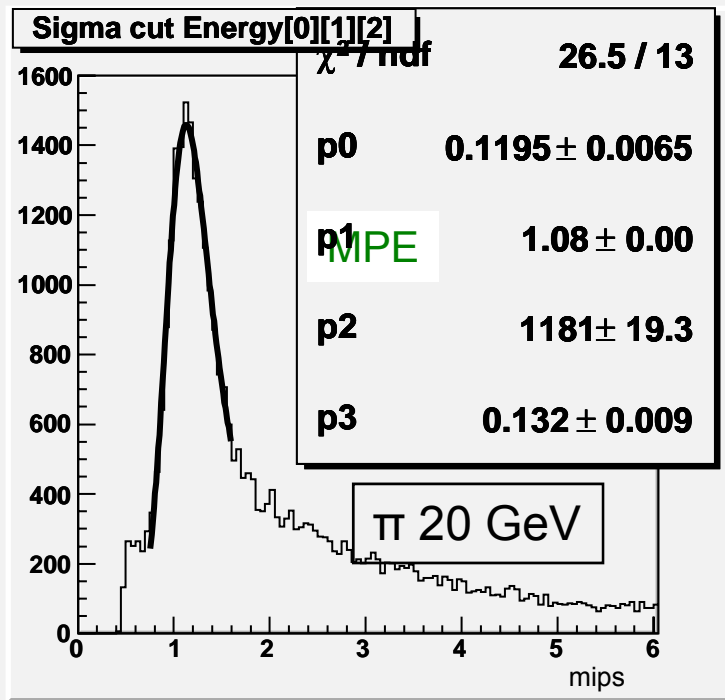
Perhaps it is due to extra noise for the 2GeV run or different incident angle?

For this study we need more Data and at various (low) energies (H4?)

Muons/Pions: Signal shapes



Layer 1 Sensor [1][2]



Sigma cut Energy[0][1][1] χ^2 / ndf 13.08 / 16

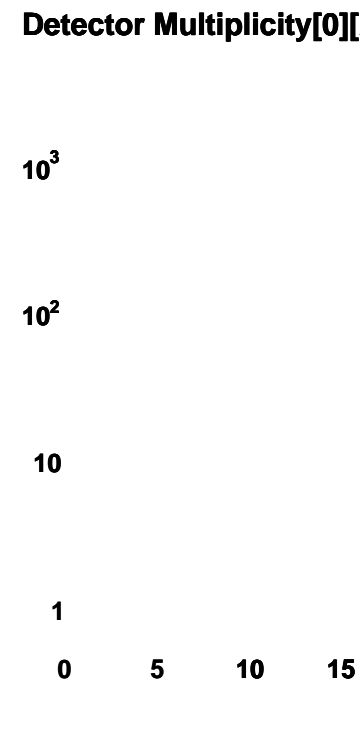
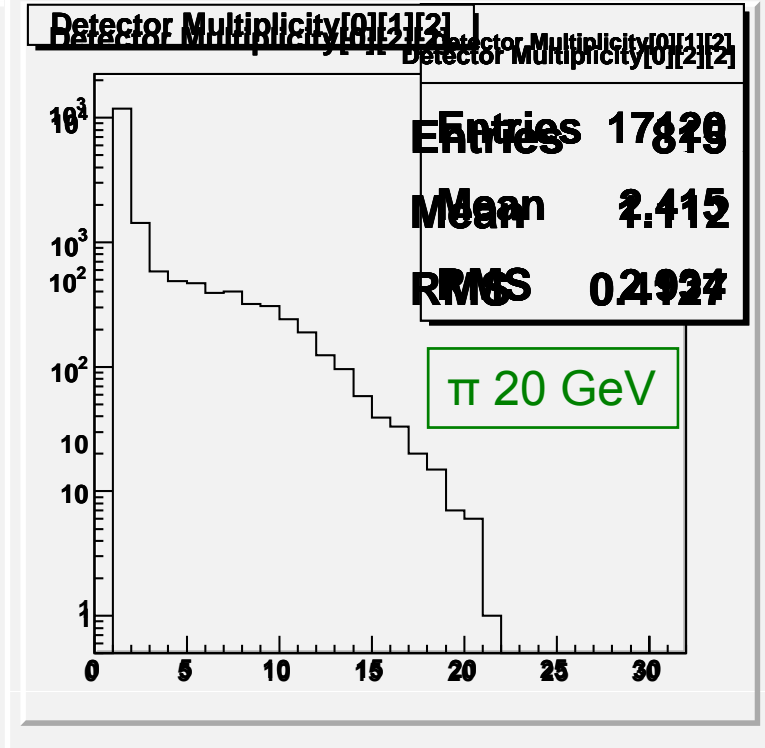
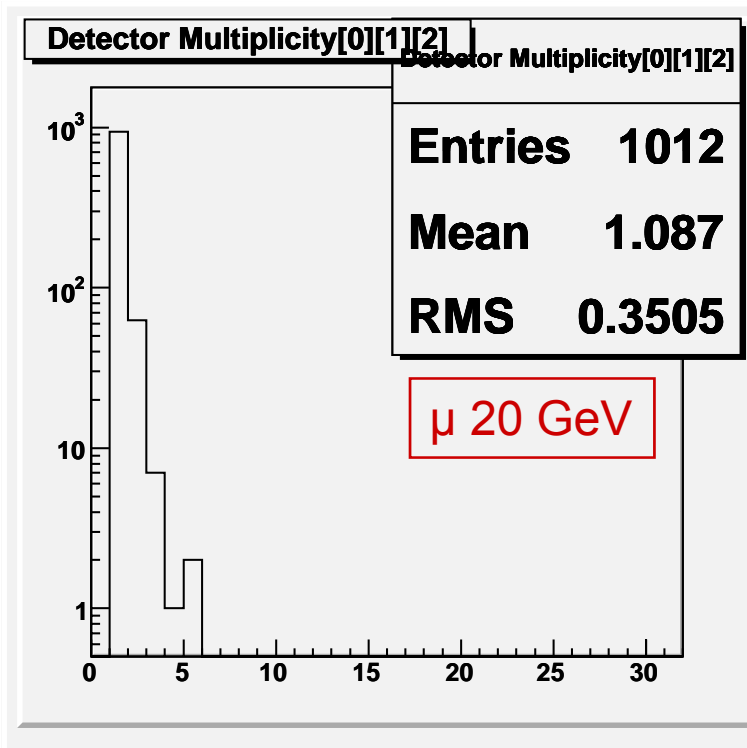
Sigma cut Energy[0][2][1] Energy[1][1][1] χ^2 / ndf 21.08 / 20 19.16 / 22

Sigma cut Energy
Sigma cut Energy
Sigma cut Energy
Sigma cut Energy
Sigma cut Energy
Sigma cut Energy

Muons/Pions: Signal shapes

- Signal shape for pions is different than muons.
- Pions undergo hadronic interactions with converters.
- MC study is needed here.

Multiplicities for : Layer 1 Sensor [1][2]



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Summary

- Extraction of muon-pion signal seems to be possible.
- Pion data can be used for calibration.
- We do not observe any energy dependence on particle energy. More data are needed and at various (low) energies(H4?).
- The shape of pion signals are different than muon ones. Pions undergo hadronic interactions with converters. MC study needed here.
- Energy calibration included in ntuple data seems ok.
- Some suggestions for HG data at H4
 - Muons: position scan with $E > 50$ GeV
 - Muons: Energy scan starting if possible 0.5-1-2 GeV up to 225 GeV
 - Pions : position scan at 50 or more GeV
 - Pions : Energy scan start if possible at 0.5-1-2 GeV up to 300GeVALL RUNs should collect at least 50K data events.